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United States
Department of
Agriculture

Forest
Service

**Northern
Region**

RIPARIAN ECOSYSTEMS: A Wildlife Perspective

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OF

RIPARIAN ECOSYSTEM MANAGEMENT:

A WILDLIFE PERSPECTIVE

Terri Ann Grotzinger
Wildlife Trainee
Northern Region
March 1980

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ABSTRACT

Management of riparian ecosystems is an important concern of the USDA-Forest Service. Numerous directives, laws, and executive orders provide the Forest Service with direction to develop sound management programs for riparian areas. This document contains information from a wildlife perspective which emphasizes the importance of riparian ecosystems and the need for adequate management of these areas. Important laws and regulations pertaining to riparian ecosystems as given by Congress, the President, and the Forest Service are reviewed as a basis for further discussion. Current direction given by such laws and regulations includes the recognition of riparian ecosystems in management planning, protection and maintenance of riparian values, and the responsibility of agencies to evaluate potential effects of action taken in the riparian ecosystem. Examples of resource values and discussion of user conflicts are provided to show the importance and complexity of managing the abundant resources associated with riparian ecosystems. Several riparian management concerns are identified as examples of efforts underway regionally and/or nationally to improve or maintain riparian areas. Discussion includes methods of mapping and inventory, determination of quality standards, possible preventive and corrective measures for riparian conflicts, and needs for further research. A brief summary of where riparian ecosystem management is going in Region 1 of the Forest Service concludes the report.

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INTRODUCTION

Concern for the management of riparian ecosystems has increased recently for the USDA-Forest Service and other land management agencies. There is 1.3 percent aquatic resources of a total 10,222,444 ha of National Forest System lands in the Northern Region (Table 1) (USDA-Forest Service 1978a, USDA-Forest Service 1978b). Actual measurements of the amount of riparian ecosystems in Region 1 have not been made. Use of data in Table 1 and several assumptions defined in Appendix A made it possible to estimate what percentage of the northern region is comprised of riparian ecosystems. Approximately 620,000 ha, or 5.9 percent, of Region 1 lands are riparian areas. Several resource disciplines find conflicting values in these areas. Recognizing the importance of riparian ecosystems, the Forest Service has intensified development of sound management plans and directions to deal with riparian ecosystem values.

The word riparian has been commonly used for several years, but its meaning has been vague. The Forest Service National Task Force Report on management of riparian areas (USDA-Forest Service 1979a) defines the riparian ecosystem as well as riparian vegetation in this way: (Fig. 1)

> "The riparian ecosystem includes the stream channel, lake, or estuary bed, the water itself, the banks, and the areas which support riparian vegetation and other characteristics that exist because of the presence of water. This definition includes those lands defined as wetlands and flood plains which support riparian vegetation (figs. 2, 3, 4).
>
> Riparian vegetation is dependent upon an excess of moisture during a portion of the growing season and the site is definitely more moist than the surrounding area."

Riparian areas include vegetation which exists due to an almost permanent supply of subsurface water and cool air drainage (USDA-Forest Service 1972). This may include such areas as wet meadows (Fig. 5) and avalanche chutes. These definitions are comprehensive, yet specific, in outlining the characteristics of the riparian ecosystem. They provide the foundation from which values, conflicts, and management of riparian areas can be discussed with a common understanding of riparian ecosystem boundaries.

It is the intent of this paper to provide Forest Service managers with current information on the importance of riparian ecosystem management. Terms are defined in Appendix B and should be referred to as the need

Table 1. Stream and lake resources of the Northern Region (USDA-Forest Service 1978a).

State	Number of Forest Streams	Streams (km)	Lakes (ha)	Number of Lakes
Montana	3,475	36,854	50,653	2,201
Idaho	2,573	17,485	95,712	605
Washington	40	161	4	1
No. Dakota	--	364	1,748	69
Region 1 Total	6,088	54,864	91,168	2,880

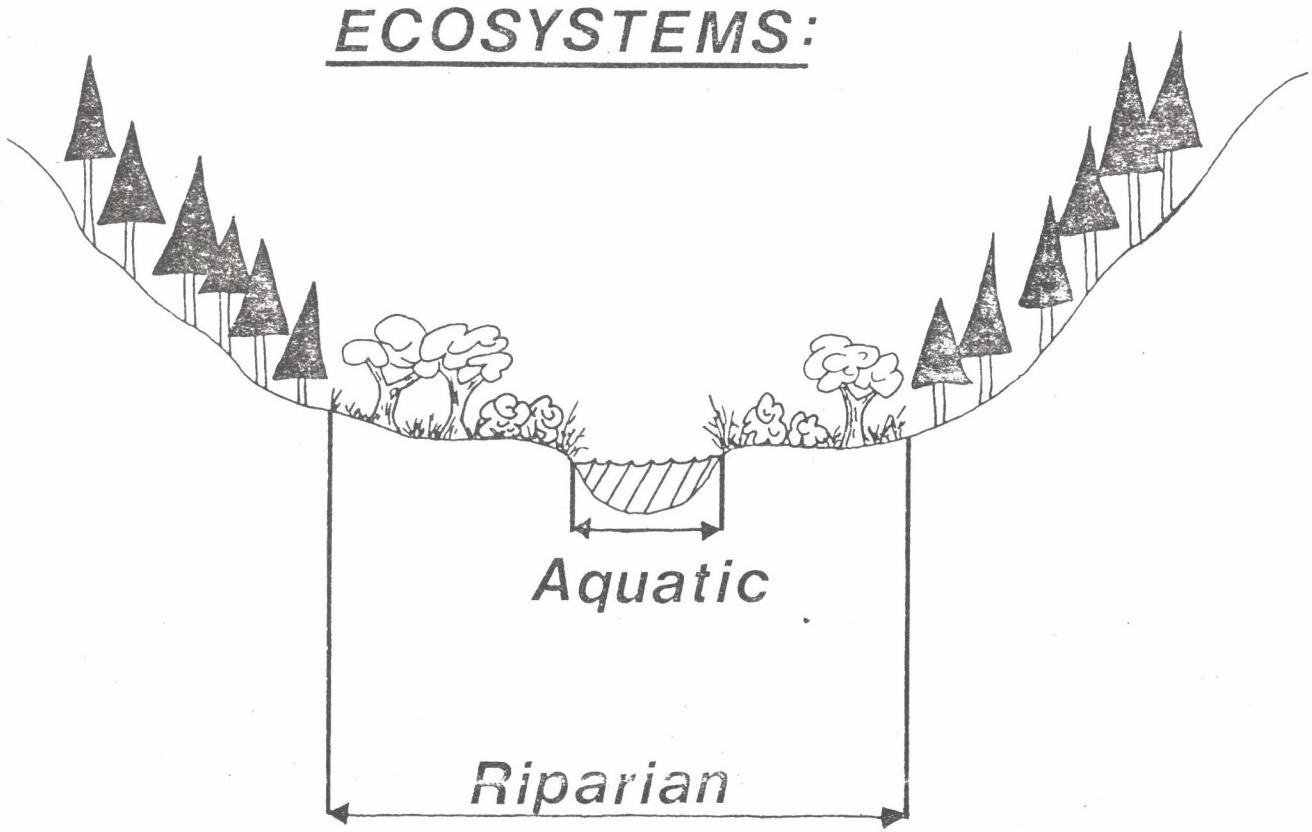


FIGURE 1 - Typical riparian ecosystem showing its relationship to the aquatic ecosystem.

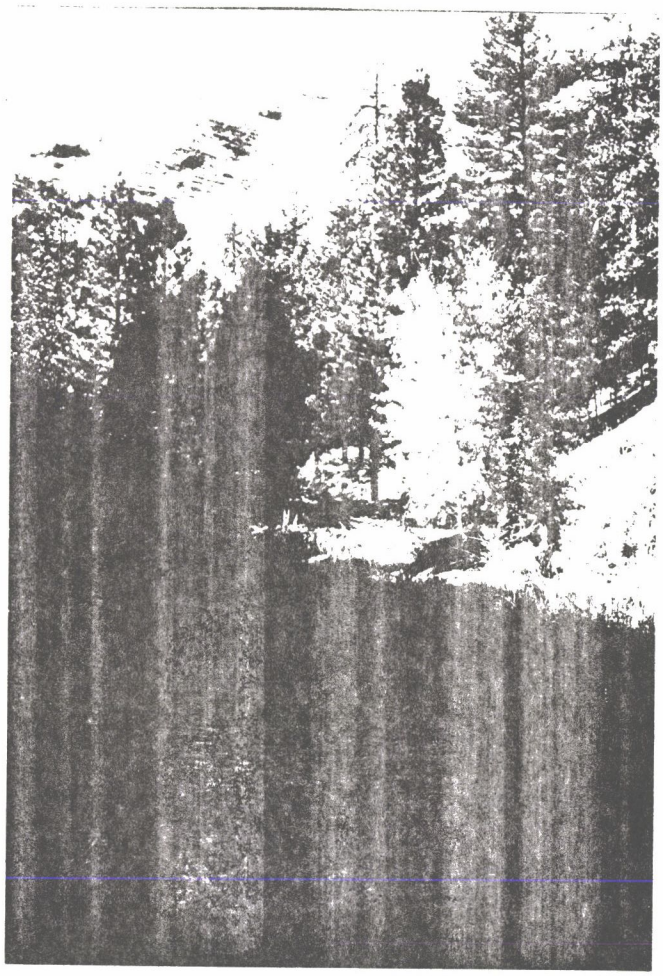


FIGURE 2 - A mountain stream with forested areas nearby is a common riparian area in the Northern Region.

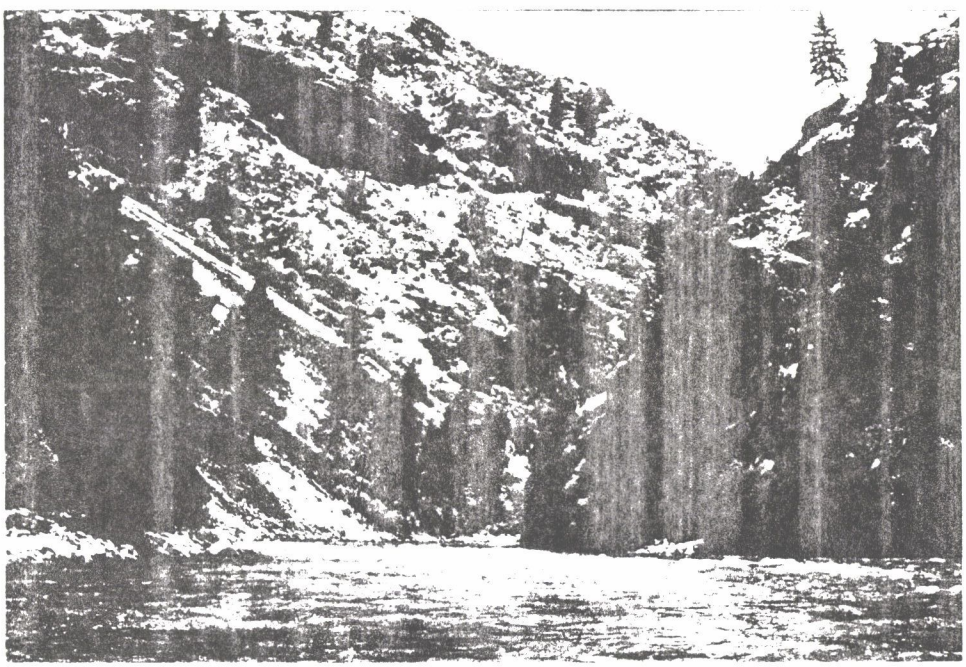


FIGURE 3 - In some cases the riparian zone is very narrow; the upland zone extending almost to the water's edge.

FIGURE 4 - Broad riparian zones occur where a wide expanse of lush vegetation encompasses a lake or pond.

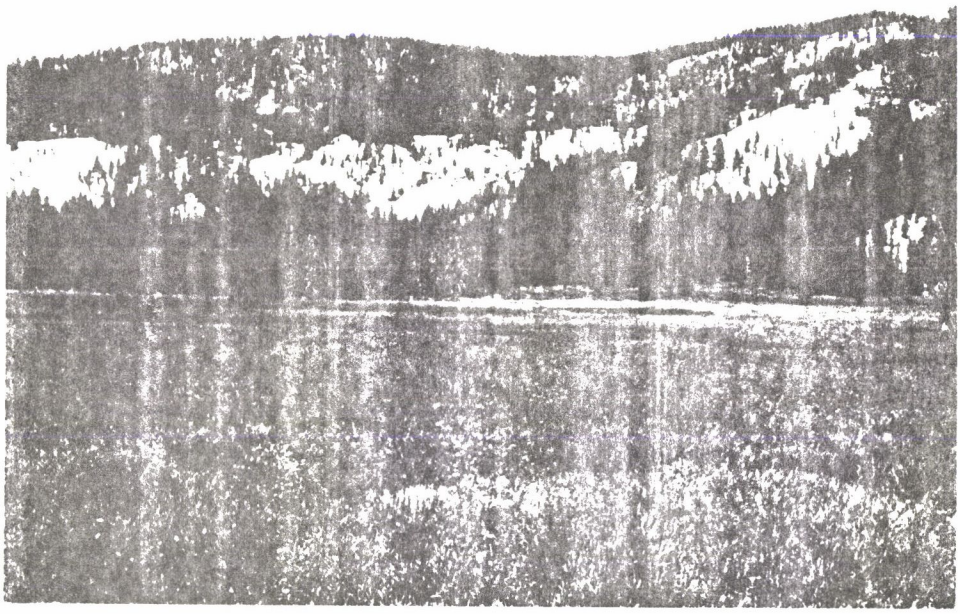


FIGURE 5 - Wet meadows in forest openings are riparian zones created by a high water table supporting lush vegetation.

arises. Important rules, regulations, and laws pertaining to riparian ecosystems are identified early as the basis for further discussion. Riparian ecosystem values and conflicts are discussed as they pertain to each resource discipline. Several management methods are reviewed as possible means of protecting riparian values and reducing user conflicts. These are not to be construed as the only methods available, but rather as examples of efforts underway to manage riparian ecosystems. A brief discussion of areas still needing research and a summary of where the Forest Service is going in riparian ecosystem management in Region 1 concludes the report.

LAWS AND REGULATIONS

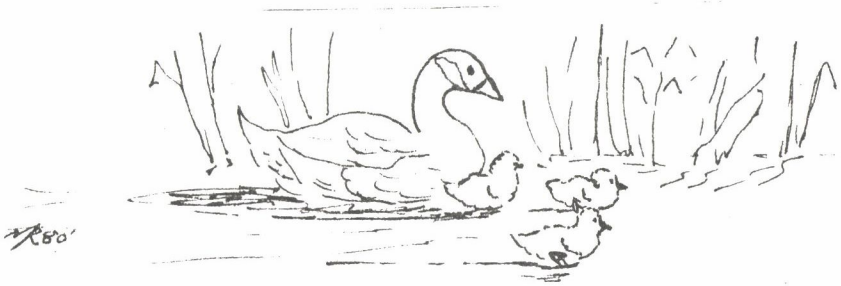
As a Federal agency, the Forest Service has a mandate to see that the laws, regulations, policies, and directives of the Government are carried out on the public lands it manages (USDA-Forest Service 1980). In developing sound management plans for riparian ecosystems, an awareness and understanding of these laws is important. Below is a compilation of the more important laws and regulations pertaining to riparian management including National Acts, Executive Orders, and National and Regional direction of the Forest Service as it pertains to Region 1.

The National Forest Management Act of 1976, (NFMA).

This law establishes direction to be taken concerning timber harvest and the protection of soil, water, and air quality values. Section 5(5)(c) states that there is a "fundamental need" to protect and, in some cases, improve these resources. Provisions include the inventory of various resources and the development of guidelines for public land management (section 6(g)), steps which need to be taken in riparian management today (USDA-Forest Service 1978c). NFMA regulations issued in September, 1979, contain an important statement pertaining to management of riparian ecosystems:

> "Special attention will be given to land and vegetation for approximately 100 feet from the edges of all perennial streams, lakes, and other bodies of water and will correspond to at least the recognizable area dominated by the riparian vegetation. No management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, and deposits of sediment will be permitted within these areas which seriously and adversely affect water conditions or fish habitat. Topography, vegetation type, soil, climatic conditions, management objectives, and other factors will be considered in determining what management practices may be performed within these areas or the constraints to be placed upon their performance"(section 219.13(e)) (USDA-Forest Service 1979b).

The term streamside corridor roughly corresponds to this definition. The streamside corridor is a management area composed of the aquatic and riparian ecosystem and a portion of the adjacent lands (Fig. 6). Essentially, it was recognized in the NFMA regulations that what happens on adjacent lands may directly impact water quality. In managing riparian ecosystems then, it is important to deal with the diversity of values found on a specific area and with multiple-use planning in mind. Direction is given as to where timber harvest on National Forest System lands is allowed and what protection is needed for riparian areas found there in section 6(g)i and iiib (USDA-Forest Service 1978c).



Executive Orders 11988 and 11990.

President Carter's issuance of EO 11988 (Floodplain Management) and EO 11990 (Protection of Wetlands) are at present having the greatest impact upon the direction of the Forest Service concerning its management of riparian ecosystems. These two orders go beyond acknowledging the importance of the riparian ecosystem. They define what actions must be taken to protect and manage the Nation's riparian resources found within wetlands and floodplains. EO 11988 requires agencies to avoid short- and long-term impacts in floodplains and requires the minimization of potential harm to natural and beneficial values found there. EO 11990 requires similar action as it pertains to wetlands. Specific direction, as given in each order in regard to riparian management, is as follows:

EO 11988
Section 1:
"Each Agency shall provide leadership and shall take action to . . . restore and preserve the natural and beneficial values served by floodplains . . . ."

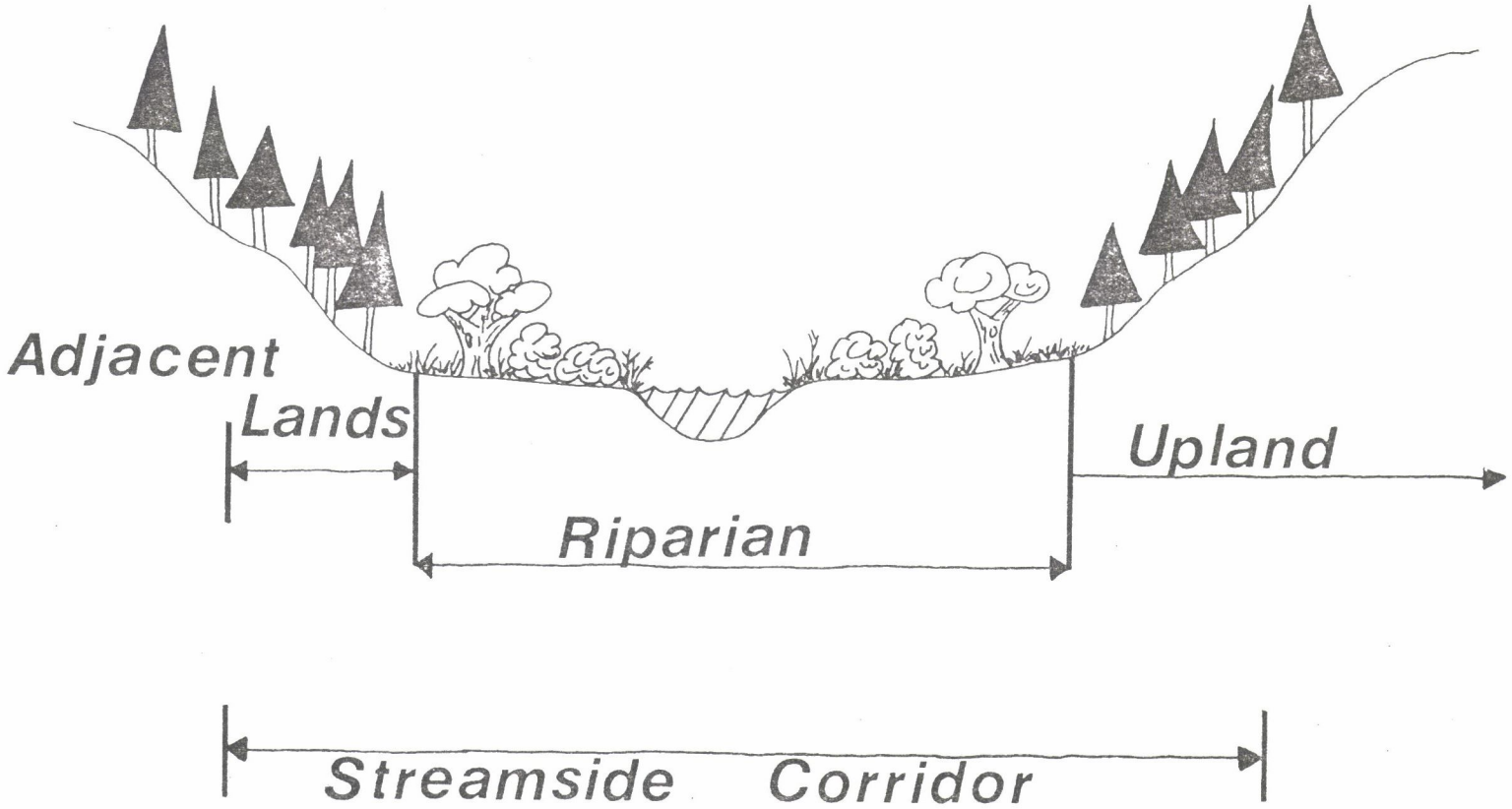


FIGURE 6 - The relationship of the streamside corridor to the adjacent lands and upland ecosystem.

Section 2:

"Each Agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain; to insure that its planning programs and budget requests reflect consideration . . . of floodplain management."

EO 11990
Section 1

"Each Agency . . . shall take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands . . . ."

Section 5

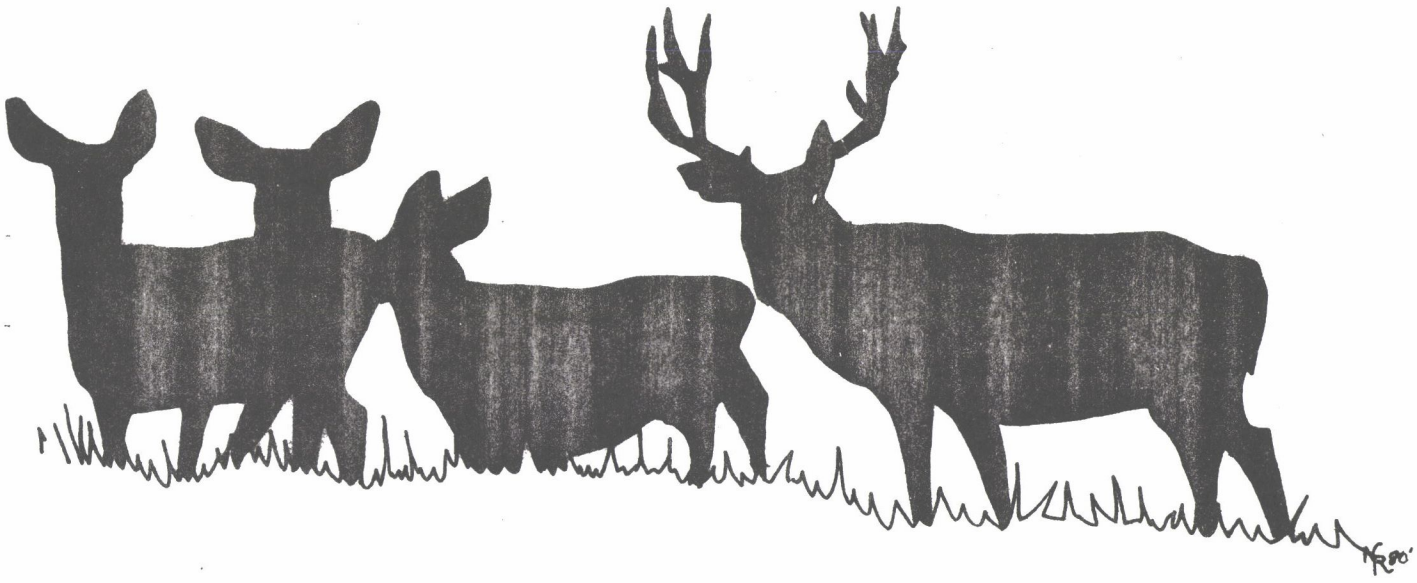
"Each Agency shall consider factors relevant to . . . maintenance of natural systems, including conservation and long-term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utitlity, fish, wildlife, timber, and food and fiber resources . . ." (U.S. Water Resources Council 1978).

Public Rangelands Improvement Act of 1978.

The Rangelands Improvement Act is the most recent National law important to riparian management. Section 2(a) states that portions of our public rangelands are producing less than their potential and are in unsatisfactory condition. Congress recognizes the need for public rangelands inventory and identification as required by section 201(a) of FLPMA, as well as the need for sound management of rangeland resources. The understanding of riparian values on public rangelands is found in section 2(a)(3) which states:

"Unsatisfactory conditions on public rangelands . . . threaten important and frequently critical fish and wildlife habitat: prevent expansion of the forage resource and resulting benefits to livestock and wildlife production; increase surface runoff . . .; reduce the value of such lands for recreational and esthetic purposes . . . ."

Direction is given to the Secretary of Agriculture to maintain an up-to-date inventory of range condition and trend. This includes the riparian zone. Funding to accomplish the direction of this Act is given in section 5(a) as provided through sections 318 and 401 of FLPMA (U.S. 95th Congress 1978).



National Forest Service Policy.

On 13 December 1978 at the Riparian Symposium at Callaway Gardens, Georgia, former Chief of the Forest Service, John R. McGuire, presented a position paper entitled "A Riparian Policy for Changing Times." (McGuire 1979) In the paper McGuire defined National Forest Service policy to meet the needs and concerns of riparian management. That policy is made up of the following four points:

--"We will plan for and manage riparian ecosystems with full recognition of their importance and unique values.

-- At the same time, we will manage riparian ecosystems as an integral component of the adjacent lands, under the principles of multiple-use and sustained yield.

-- We will protect and, where applicable, improve the riparian ecosystems--that is, the soil, water, and vegetation--as one of our basic stewardship responsibilities. This will be done prior ro, or in conjunction with, other resource allocation decisions.

-- We will also, as policy, continue research programs on the management, ecology, and protection of riparian environments for water, fish, wildlife, timber, livestock, recreation values and uses."

Interpretation of this policy was outlined by McGuire, emphasizing how the policy "will be" incorporated in Forest Service planning. Direction soon to be given, as identified by McGuire, includes:

--"Riparian management will encompass the requirements of Executive Order 11990 for wetlands and Executive Order 11988 for floodplains, particularly the requirements to avoid, to the extent possible, adverse impacts from activities on the riparian ecosystem.

-- Public participation in all our planning and management--including that for riparian ecosystems--is assured through the National Forest Management Act.

-- Land management plans will specifically state objectives for riparian ecosystems.

-- We expect to classify riparian ecosystems in the Forest Service National Land Classification System that we use in Land Management Planning. Riparian ecosystems and associated lands will be inventoried and delineated as "Capability Areas" on the National Forest System.

-- Interdisciplinary teams will identify alternatives for protecting and managing riparian ecosystems as planning is done on each Forest or Grassland.

-- Our land managers will use environmental assessments to evaluate both the individual and cumulative effects of proposed actions in riparian ecowystems. This will insure that the natural and beneficial values of these ecosystems are protected as the President directed.

-- The actual on-the-ground effects of our actions within and adjacent to riparian ecosystems will be monitored and evaluated, keeping in mind the considerable expense associated with monitoring.

-- Riparian ecosystems planning and management on the National Forest System will be coordinated with other Federal Agencies, the States, and local Governments."

National Forest Service policy thus reveals an understanding of the need for proper management of riparian ecosystems. The policy also specifies the ways and means for action to comply with this direction.

Region 1 Policy and Direction.

Region 1 is now formulating its policy and direction for riparian management in Title 2536 of the Forest Service Manual. That policy will be based on the national policy set down by Congress, the President, and former Chief McGuire. Several supplements dealing indirectly with riparian ecosystem management are already available throught the Directives System in Forest Service Manuals 7700 - Transportation System, 2500 - Watershed Management, and 2200 - Range Management. Others will follow as resource managers from other disciplines develop guidelines for riparian management.

Title 7700, chapter 7706.1, gives policy for the construction of roads in riparian zones. Decisions to allow or avoid projects are determined by direction given as to the quality of the water resource and fish habitat present on the site. Vegetational relationships to fish habitat needs are provided as well as specific direction about where roads may and may not be constructed (USDA-Forest Service 1976a).

Title 2500 provides performance criteria for the environment, water quality, esthetics, and recreation. These criteria allow for monitoring changes in water quality, velocity, and temperature, all of which effect fish habitat quality. Consideration is given to streamside vegetation protection and to soil erosion problems caused by a lack of vegetation. Its main objective is to avoid "adverse impact on onsite and offsite aquatic ecosystems" (USDA-Forest Service 1973).

One of the most important supplements to come out concerning riparian zones is Forest Service Manual 2200, chapter 2241.2. This supplement deals with funds which can be obtained through the Range Betterment Fund as authorized through FLPMA and amended by the Range Land Improvement Act of 1978. Funds are made up of 50 percent of the grazing receipts from National Forest lands in the 16 western States to improve rangelands. Only on-the-ground costs for improvement are covered. These include:

--"Construction of fences and water developments for livestock control and management.

-- Fencing of spring sources and water developments.

-- Temporary fencing to allow reestablishment of riparian and other vegetation where the principle cause of deterioration was grazing.

-- Protection fencing of deteriorated, fragile ecosystems that cannot otherwise be protected or managed through grazing system design or livestock management practices" (USDA-Forest Service 1979c).

Additional funds can be obtained through Knudsen Vandenberg funds to maintain or improve riparian areas. The funds "may be used to purchase seed, cones of noncommercial tree species, or shrubs planned for mitigation and enhancement of other resource uses amended under the K-V Act" (USDA-Forest Service 1978d), and may be beneficial to riparian ecosystem management.

RIPARIAN ECOSYSTEM VALUES AND CONFLICTS

It is difficult to put values on ecosystems. There can be no doubt that the riparian ecosystem is valuable to several users. The riparian zone produces more than its meager size incdicates. Odum, in his standard text on ecology, recognized the importance of the riparian zone, although he never referred to it specifically. Rivers are the most intensely used by man although small in comparison by total surface area to the oceans and land surface (Odum 1975). Skovlin et al. (1977) recognized mountain streams and their adjacent riparian habitats "as the most productive and geologically the most diverse combination of communities within the surrounding habitats." The fact that there are so many users and resource values found in the riparian ecosystem, including wildlife, fisheries, timber, range, aquatic resources, and recreation, only emphasizes the importance of these zones. It is important to identify values in the riparian zone so that conflicts can be predicted and sound management developed to provide for values and avoid conflicts as much as possible.

The abundant values of riparian ecosystems leads to inevitable conflicts. Riparian zones can support a diversity of uses provided no single use dominates the system. According to Brown et al. (1979):

> "A riparian wetland is highly productive and can sustain a considerable harvest of biomass as long as the physical forces responsible for the high rate of energy flow and productivity remain intact. When these forces are altered (i.e., by diking, damming, channelization, levee building, road construction, herbicide accumulation, sedimentation, and excessive grazing . . .) the ecosystem loses its vigor and rapidly deteriorates."

Conflicts must be identified so that sound management decisions can be made concerning actions taken in riparian zones.

Roads

Roads are often constructed on streamsides and through wetlands because construction costs are less, and access is easier and less expensive where topography is flat (Jahn 1979). This is highly desireable from an engineering viewpoint. Road development in the riparian ecosystem is required, to some extent, for access into favorable sites for timber harvest and recreational activities. Riparian areas are often the most esthetically pleasing and desirable sites for road development.

Road construction affects riparian ecosystems in several ways. Removal of vegetation associated with road development leads to increased soil erosion from steep cut and fill slopes and from the road surface itself (USDA-Forest Service 1979a). This, in turn, reduces water quality by increasing sediment loads. Often, roads bisect wildlife travel lanes and thus reduce th usefullness of the riparian ecosystem for some wildlife species. Roads reduced the amount of effective habitat available to elk (Cervus elaphus) not only by their presence but by the amount of vehicular use on them (Lyon 1979).

Timber

Timber values can be quite high in riparian ecosystems. The availability of water, highly enriched and well-developed soils, and the deposit of silts in floodplain areas promote vigorous growth of timber in the riparian ecosystem (Jahn 1979).

Timber harvest has similar impacts to those of road construction in riparian ecosystems. Fisheries impacts occur where high sediment loads impact the spawning sites of anadromous fish (USDA-Forest Service 1979a). Reduction of shade by removal of bank vegetation increases water temperatures and may be detrimental to the fishery resource (USDA-Forest Service

1979a). Migration of fish may be impeded where debris and slash from logging occurs. This accumulated debris may also produce an excessive biochemical oxygen demand due to the process of decomposition.

Recreation

Recreational values found in the riparian zone are numerous and greatly interrelated with other values. This zone attracts outdoor enthusiasts of all kinds from consumptive users such as fishermen, hunters, or flower collectors to nonconsumptive boaters, hikers, picnickers, or simply sightseers (Brown 1979). There continues to be rapid development of mountain stream and lakeside vacation homes where desires and needs for esthetics, access to available water, and gentle terrain are provided.

Conflicts are inherent among recreational demands on the riparian zone where a variety of activities may occur on a limited area. Creation of campgrounds involves removal of vegetation and, with use, increases soil erosion and bank deterioration along streambanks and lakeshores (USDA-Forest Service 1979a). Hiking and backpacking increase soil compaction and water runoff. Increased recreational use leads to increased wildlife conflicts, either consumptively or nonconsumptively, through competition for living space, food, cover, and water needs (Thomas et al. 1979).

Livestock and Range

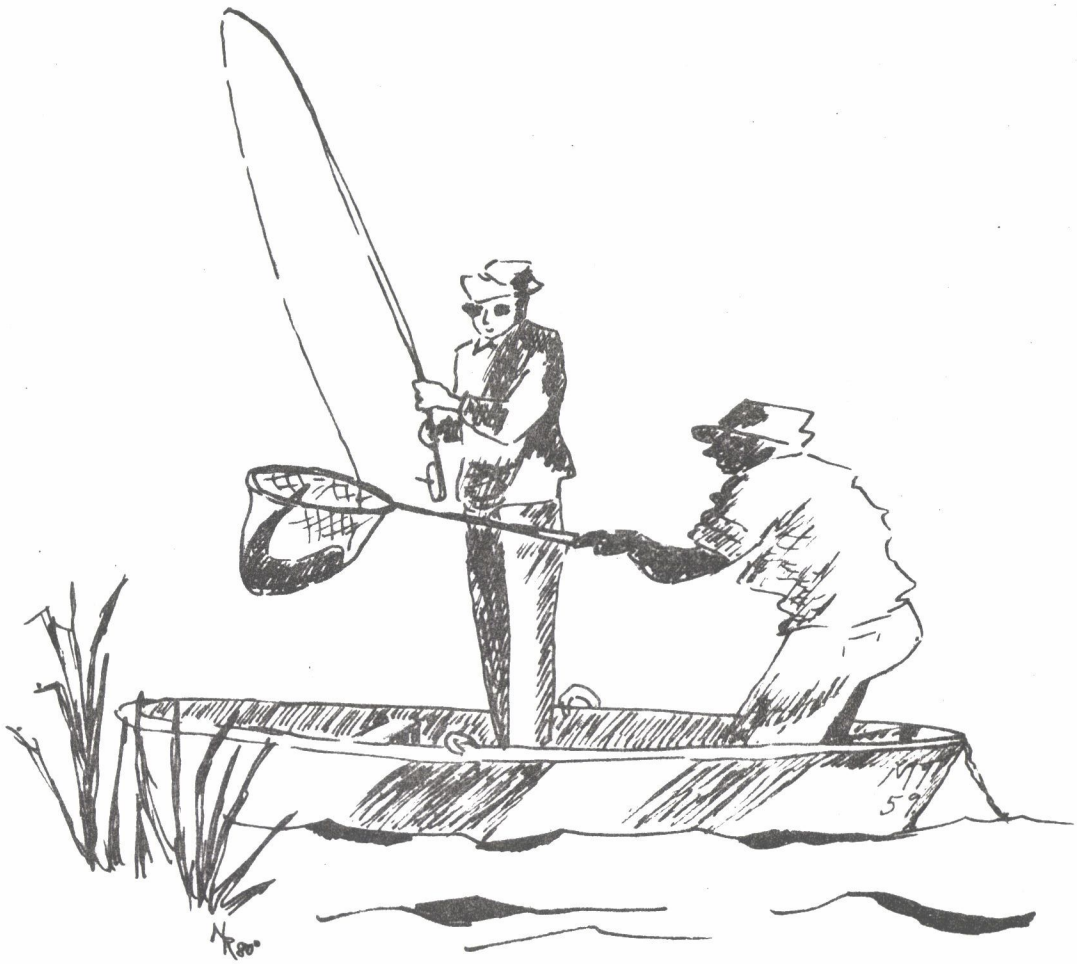
Utilization of riparian areas by livestock has been important to the development of the livestock industry. Ames (1977) cited several reasons for cattle use of riparian zones including availability of water, shade, ease of topography, and both the quality and variety of forage available there. Forage is generally more palatable due to the presence of more moisture and thus sought after by livestock (Ames 1977).

Conflicts involving livestock have promoted criticism of grazing practices in riparian ecosystems more than any other activity occurring there. Livestock impacts include removal and trampling of vegetation, sloughing of streambanks, and resultatt increases in soil erosion and sediment loads in the water resource (USDA-Forest Service 1979a). Removal of bank vegetation may increase water temperatures by reducing shade from overhanging vegetation (Oregon/Washington Interagency Wildlife Committee 1979). These may reduce the quality of fish habitat present to some degree, depending on the species involved.

Aquatic Resources and Fisheries

Aquatic and fisheries values should be the most obvious values in riparian ecosystems. Water is the basis for the entire riparian ecosystem (Kennedy 1977). It supports riparian vegetation, the fishery resource, and numerous

wildlife species found in the system. The fisheries resource depends on the quality of the system from the water to the streamside vegetation and soils. In Region 1 this includes anadromous fish as well as other cold and warm water species. Fisheries values include shade cover and bank stability provided by bank vegetation (Meehan 1977, Nelson et al. 1978), and the presence of spawning, feeding, and rearing sites not inundated by excessive sediment loads.



Most uses in the riparian ecosystem have some impact on aquatic and fisheries values. Degradation of spawning areas by sedimentation (Hoffman and Stanley 1978), breakdown of streambanks, and increased water temperatures affect water quality and fish habitat. Uses of water downstream are also impaired through increases in sediment loads. Channelization of streams and rivers increases the power of the water to carry sediment, adding to the scouring effect of water on banks (Karr and Schlosser 1978).

Wildlife

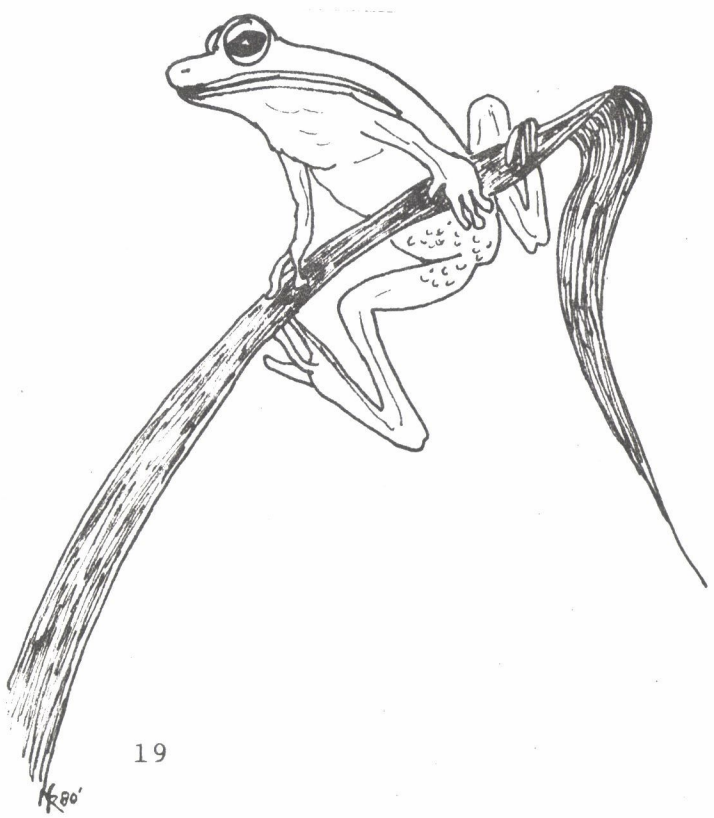
Wildlife values associated with the riparian ecosystem are numerous and varied. In many cases, riparian ecosystems are critically important to plants and animals (Hubbard 1977). A recent study showed the riparian zone contained the highest diversity and density of snag dependent wild life on the Kootenai Forest of the Northern Region, providing habitat for such species as the American Osprey (Pandion haliaetus), Great Blue Heron (Ardea herodias), and Pileated Woodpecker (Dryocopus pileatus) (Godtel et al. ----). Thomas et al. (1979) found that riparian ecosystems were a critical source of diversity for both plants and wildlife. With greater availability of water to plants, there was greater vegetative growth, species diversity, and structural stratification which in turn provided habitat for diverse wildlife.

Riparian zones come in a variety of patterns, shapes, and sizes and thus maximize edge development, a factor important for wildlife. Riparian areas often act as travel lanes for wildlife to food and cover, or to and from seasonal ranges. There is a greater plant and animal biomass in the riparian zone than in surrounding areas in terms of productivity (Thomas et al. 1979). Carothers and Johnson (1975) found one of the highest densities of breeding bird populations in North America where 1,059 breeding pairs per 40 ha utilized a cottonwood riparian zone.

Wildlife use causes impacts to the riparian area when excessive numbers impact the system by trampling and removal of vegetation. But, in general, wildlife values are most often impacted by the activities of man in manipulation of the ecosystem. Increased recreational use and construction of roads and summer homes have reduced riparian habitat available for wildlife. Reduction of horizontal and vertical vegetative stratification affects the diversity of both plants and wildlife inherent in the ecosystem (Thomas et al. 1979). Both decline in diversity where excess modification occurs in the riparian zone.

MANAGEMENT TECHNIQUES

The numerous values, uses, and conflicts found in the riparian zone necessitates development of sound management techniques for these areas. Action taken in these areas will affect the ecosystem whether that action is unplanned or involves intensive preplanning and project followup. The complexity of the riparian ecosystem requires research to enhance knowledge and further develop management skills in planning for riparian areas. But management development cannot wait for all the necessary research while multiple use of riparian areas continues. Managers need to use all the skills presently available in planning today. As further research is completed, management direction and knowledge should be revised and improved. Without correctly managing riparian areas, much of this valuable resource will be lost.



At present, there are bits and pieces of information that could be used in riparian planning and habitat management scattered throughout numerous agencies and disciplines. Information available includes management concerns such as: mapping and inventory methods, determination of quality standards, and possible preventive and corrective measures for riparian ecosystem comflicts. Much effort is needed in the development of new or modified management techniques to be used in riparian ecosystems. No attempt was made in this report to state exact procedures to follow for the examples of management techniques provided. Each riparian ecosystem considered must be evaluated on an individual basis. A comprehensive review of management techniques available for use in riparian management should be developed as a greater understanding of ecological relationships in riparian areas is found.

Mapping and Inventory

Work is underway in Region 1 to develop a mapping method to include the inventory of riparian ecosystems as an integral part of the Order III Land System Inventory in Forest Service Land Management Planning (USDA-Forest Service 1979d). This method may insure recognition of riparian areas by detailed description and mapping (where feasible) in the planning process. Use of aerial photos, preferably color or infrared, may be helpful in defining these areas as well.

Inventories should be made as to the species of vegetation, wildlife, and fish present in specific riparian zones. The current species condition can also be determined. Data compiled can be compared with defined quality standards to determine management action. Aerial photography was successful in identifying white alder (Alnus rhombifolia) drainages in Idaho. A scale of 1:15,840 was adequate for white alder identification. Larger scales were necessary for information on species composition (Miller et al. 1976). Infrared photography is being used on the Beaverhead National Forest to inventory damaged streambank areas. This technique combined with field reconnaissance may be a means to direct habitat improvement in such areas (C. Sundstrom pers. comm.).

The Bureau of Land Management has developed an extensive inventory method for riparian zones in Colorado. Sampling includes the riparian/upland interface, the associated aquatic areas, and a stream survey whenever possible. Vegetative composition (i.e. the horizontal and vertical structure), wildlife species occurrence, habitat edge, hydrologic character, and utilization by wildlife and livestock are recorded. The method utilizes an interdisciplinary approach and minimizes time involved in data collection and interpretation. Most importantly, the method quantifies the effects of grazing and foraging on riparian ecosystems (Hess, H. 1978, Gregg 1978).

Region 1 has no single inventory method for use exclusively in riparian areas (USDA-Forest Service 1979b). Techniques are available for inventory of vegetation, wildlife, and fish, and can be adapted for use in riparian areas. The Wildlife Surveys Handbook (USDA-Forest Service 1969) provides information as to inventory methods suitable for big game, small game, and threatened and endangered species habitat requirements. This includes utilization and production studies, pellet-group counts, and food and reproduction studies. The R-1 Stream Reach Inventory and Channel Stability Evaluation provides for the inventory of the fisheries resource (USDA-Forest Service 1975a).

Quality Standards

Standards are being defined as to the quality of riparian ecosystems. Such standards will include water and vegetative quality as well as cover, shade, and esthetic qualities. Although water quality may be adequate, requirements for terrestrial species may not be. It is important that all factors receive consideration. Standards devised will depend on the species found at and uses to be obtained from each site. Some sites will have higher quality standards than others depending on the potential of each. Quality standards have been devised for habitat management of the fisheries resource and numerous wildlife species. Several are discussed below as examples of quality standards needed in management of riparian ecosystems.

A wealth of information is available concerning habitat quality for fisheries. Standards include such factors as stream temperatures, amount of available cover, sedimentation loads, and the presence of certain macroinvertebrates (Munther et al. 1978). Each has an impact on the fishery resource. The following guidelines were developed for quality fish habitat in Oregon and Washington (Oregon/Washington Interagency Wildlife Committee 1979):

--"Stream Surface Shaded. Between 60 percent and 100 percent of the stream surface should be shaded from June to September during the hours of 10 a.m. and 4 p.m." The vegetation provides not

only for shade but terrestrial insects as well. The amounts of streamside vegetation needed are influenced by water depth, turbulence, and size of stream involved.

--Streambank Stability. Streambanks should have 80 percent or more of their total linear distance in a stable condition." This helps to provide shade, reduce sediment erosion from banks, and maintain stream depths. Vegetation is important in holding the soil intact, thus reducing erosion.

--Streambed sedimentation. No more than 15 percent of stream substrate should be covered by inorganic substrate." This is important for spawning sites, production of invertebrates, and maintenance of quality pools.

Region 3 has a stream evaluation technique which determines the quality of streams by rating the physical habitat, water quality, and biological habitat present (McKirdy 1975). Further standards for the fishery resource are found in chapter 600 of the Wildlife Surveys Handbook (USDA-Forest Service 1969) and from information developed for use with the R-1 Stream Reach Inventory and Channel Stability Evaluation form.

The presence of certain freshwater invertebrates can indicate good water quality (Table 2) (McKirdy 1975). Displacement of these invertebrates by those more tolerant to pollution may give clues to poor riparian habitat management. A study in California found aquatic invertebrate communities were good indicators of streams logged without adequate stream protection (Roby et al. 1977). Streams with buffer strips 30 m in width or greater showed no effects of logging, while those with narrower strips varied in the amount of stream protection provided. Logged streams showed a reduction in invertebrate diversity. Pollution problems may be caused by poor management of upland areas rather than poor riparian ecosystem management, therefore use of invertebrates as indicators should be used in addition to other quality tests.

Standards for wildlife in riparian zones have not been specifically defined for all species involved. Many species utilize these areas only seasonally for travel lanes or other needs. Others, some of which could be called indicator species, require the riparian ecosystem for their habitat needs year-round. These include the Yellow-headed Blackbird (Xanthocephalus xanthocephalus) (Weller et al. 1973, Hess, H. 1978), and the tailed frog (Ascaphus truei) (Marcot 1979a). Below are examples of quality standards for several wildlife species frequenting the riparian ecosystem.

There are standards of quality riparian habitat for such species as the beaver (Castor canadensis). The beaver utilizes aspen (Populus tremuloides), various species of cottonwood (Populus spp.), and willow

Table 2. A list of freshwater invertebrates whose presence can be used as indicators of good water quality (McKirdy 1975).

Groups (Taxa)		Association With Pollution*
Caddisfly (Larvae)	Trichoptera	Sensitive
Mayfly (Nymph)	Ephemeroptera	Sensitive
Stonefly (Nymph)	Plecoptera	Sensitive
Scud	Amphipoda	Sensitive
Cranefly (Larvae)	Diptera	Slightly Tolerant

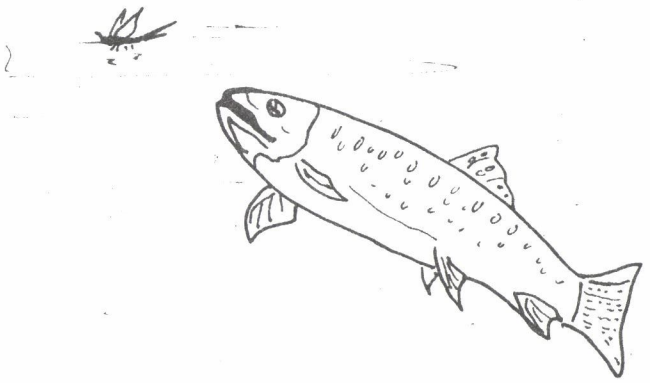
*Species diversity may be used to determine the effect of a pollutant on a community.

Assumptions:

1. A change in an environmental parameter (a pollutant) causes a change in community structure.

2. A change in community structure causes a change in diversity.

3. The nature of the change in diversity is such that increasing amounts of environmental change (or pollution concentration) result in decreasing diversity.



(Salix spp.) for food (Slough and Sadleir 1977) and cover. Williams (1965) found the depth of water for protection from enemies, travel, and the storage of a food supply in the lodge to be important habitat factors for beaver.

Some nongame species also require optimum riparian lands. Two such species are the northern water shrew (Sorex palustris) and the Long-billed Marsh Wren (Cistothorus palustris). Studies of the northern water shrew showed quality habitat to be areas within 18 cm of the water's edge (Conaway 1952) and no more than 3 m from surface water (Rand 1944). Streambanks composed of large stones, boulders, and tree roots forming many crevices provided optimum habitat (Conaway 1952, Brown 1967). Feeding requirements of the Long-billed Marsh Wren include availability of aquatic invertebrates in standing water (Welter 1935, Verner and Engelsen 1970). These areas are also required for breeding and reproduction. As with avian species mentioned earlier, these species could help managers identify the conditions present in riparian areas.

Several studies revealed the importance of riparian vegetative stratification to diversity of nongame birds present in the riparian zone (MacArthur and MacArthur 1961, MacArthur 1964, Weller and Fredrickson 1973, Hess, C. J.

1978). Vertical stratification rather than plant species diversity accounts for high avian diversity (MacArthur and MacArthur 1961). A cover to water ratio of 70 percent open water, robust vegetation with openings, and available nesting sites over water are considered optimum for the Yellow-headed Blackbird (Weller and Fredrickson 1973). Managing nongame bird populations in wetland areas is important as they are an integral part of the ecosystem, highly visible and correlated with habitat structure, and important to many outdoor recreationists (Hess, C. J. 1978). Monitoring such species may prove helpful to riparian management as indicators of ecosystem degradation or quality.

Riparian habitats in montane zones were utilized by elk in summer to obtain succulent forage and shade, as calving areas in the spring (Fig. 7) and wallowing sites in the fall (Fig. 8) (USDA-Forest Service 1976b, Edwards and Burbridge 1978). Marcum (1975) found that habitat conditions for elk from June through November included areas within 137 m of water, and for the entire study period comprised areas within 46 m of water (USDA-Forest Service 1976b, USDA-Forest Service 1977b). Munther et al. (1978) cited a recent study in which elk spent 40 percent of their time in riparian zones that made up only 8 percent of their seasonal range. Elk were provided thermal cover and travel routes, both daily and seasonally, in riparian areas (Munther et al. 1978, Thomas et al. 1979).

Pengelly (1973) found winter use of riparian zones to be important for the white-tailed deer (Odocoileus virginianus). Deer, like elk, used riparian zones for cover, succulent forage, and as travel lanes (Edwards and Burbridge 1978).

Several endangered and threatened species rely heavily on quality riparian habitat. The endangered Bald Eagle (Haliaeetus leucocephalus) feeds primarily on waterfowl and fish during winter; in western Montana the primary source is kokanee salmon (Oncorhynchus nerka). Winter is a critical season for eagles, and riparian zones serve as quality winter habitat for them. The Clearwater National Forest defined eagle habitat as generally within 0.8 km either side of its major drainages (USDA-Forest Service 1978e). The grizzly bear (Ursus horribilus) seeks out succulent forbs and the seasonal fruits of shrubs found in avalanche chutes, stream bottoms, and wet meadows (Mealey 1977, Mealey et al. 1977). These sites are used primarily in late spring and early summer, but may be utilized off and on throughout spring.

The needs of amphibians and reptiles for quality riparian habitat is often overlooked in management planning. Herps are dependent on riparian zones for feeding and reproduction. A few species reside almost entirely near water: the tailed frog (Ascaphus truei) and the tiger salamander (Ambystoma tigrinum) are two examples (Marcot 1979). Others may travel

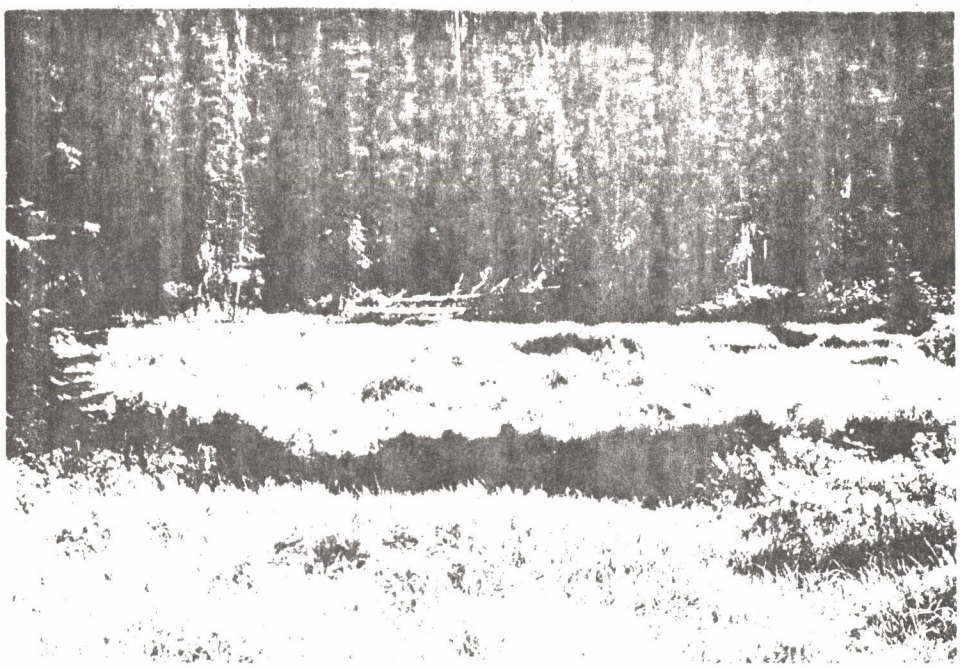


FIGURE 7 - Mountain parks often have large wet meadows important to elk for feeding and calving.

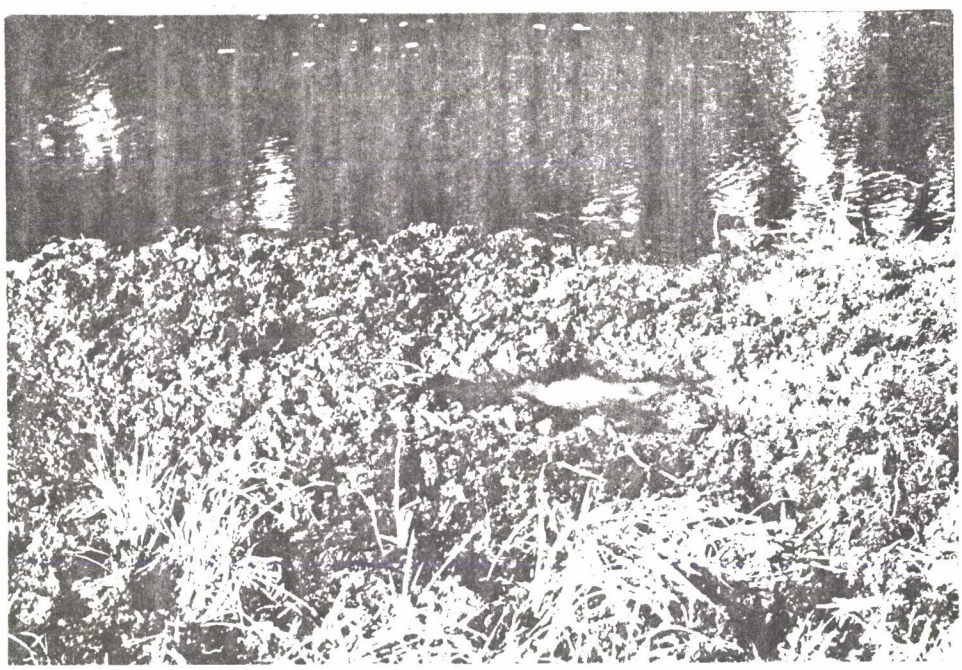


FIGURE 8 - The riparian zone includes elk wallows, an important component of summer elk habitat.

further from water, but will remain within the riparian ecosystem for feeding, breeding, and/or reproduction.

Corrective and Preventive Approaches

Decisions as to what management should be used to correct or prevent further damage to riparian zones must be determined once conflicts are identified. Management direction should be derived from inventory data and designed around the specific needs and quality standards of each riparian zone reviewed. It should be noted that proper management of riparian zones does not guarantee protection of aquatic and fisheries resources, due to the effects of upland management, but is an important aspect of protection of these resources. Several approaches are discussed below:

Road Construction

Road construction more than any other management action has a critical and long-lasting effect on riparian areas (Thomas et al. 1979). In response to Executive Orders 11988 and 11990, Region 1 supplements to the Directives System have been updated to deal with road construction problems.

Specific criteria to be followed in road construction is set forth in R-1 Supplement No. 45 (USDA-Forest Service 1979e) for the protection of riparian resource values. Major points of the supplement as they pertain to every transportation system activity are:

--"Riparian vegetation shall be managed to comply with acceptable water quality standards in all streamside transportation activities.

-- Erosion and sediment control procedures will be utilized in the development and operation of roads and landings to prevent sediment or debris from reaching streams.

-- Protect water quality, fish habitat, and soils by involvement of the appropriate specialists in the areas under consideration.

-- Proposed transportation projects shall not be developed if water quality and fish habitat cannot be protected.

-- If unacceptable water quality and fish habitat degradation occurs during transportation facility construction, all reasonable avenues to correct the degradation will be pursued.

-- Onsite and offsite water management shall be considered in location and design of transportation facilities to prevent accelerated soil erosion and desynchronization of water movements (to mitigate offsite water impacts)."

Timber Harvest

Management of the riparian zone in regard to timber harvest mitigation in Region 1 has been through the Directives System (USDA-Forest Service 1979a). Major concerns are in regard to road construction and yarding. These have been covered somewhat by the discussion above as well as other Regional supplements and legislation. Direction includes maintenance of buffer strips to filter sediment before it reaches water resources and consideration of land and vegetation within 30.5 m of streams, lakes, and other bodies of water. Specifically, "sale planning must ensure that adequate erosion control measures have been considered and provided for in appraisals and contracts" and timber purchasers are required to protect water resources through removal of slash in streamsourses (USDA-Forest Service 1974). Timber management must consider multiple use goals for each area and maintain site productivity and conservation of soil and water resources. Wildlife and fish habitat management objectives must be integrated in timber management prescriptions sot that habitat needs are considered (USDA-Forest Service 1979b).

Recreation

The esthetics of a clear mountain stream or lake where one can camp, fish, or just enjoy wildlife nearby is important for recreation. Maintaining these qualities, while at the same time providing access to riparian areas, is difficult. Recreation management in riparian ecosystems requires several tradeoffs. Preplanning is necessary to identify tradeoffs and know how to minimize or mitigate impacts. Site protection through maintenance of vegetation, erosion control, and placement of sanitary facilities away

from bodies of water is an important aspect of planning (USDA-Forest Service 1967). Specifically, "facilities and roads will be judiciously located as necessary to avoid overuse, misuse, or abuse of lakes, ponds, and streams" (USDA-Forest Service 1975b). Backcountry use can be controlled in heavily used areas through use of downfall, rocks, revegetation, and restrictions as to camping distances from lake and streamsides. Information about user values gathered on each site must be weighed against one another to determine which values to manage for or against (Johnson et al. 1977).

Livestock and Range

The grazing of livestock in riparian zones has, without a doubt, recieved the most attention of any riparian use. Managers of all disciplines have met at several symposiums to discuss the issues and problems inherent with livestock grazing and the riparian zone. In addition, numerous articles have been written to further this discussion. Below are some major points of information presently available to managers.

Several grazing strategies are available for use in riparian zones including rest-rotation, timing of forage use, and use of various classes of livestock and animal stocking rates (Behnke et al. 1977). Problems arise when trying to determine which strategies are best in each area and/or which combinations would prove most successful in plans for livestock management. No textbook system of grazing will solve all riparian problems (Wamboldt 1979). An evaluation of what is known about these systems, however, may lead to the development of modified systems which can be used for management in these zones.

A solution which has received considerable attention is fencing of riparian zones (Dahlem 1979, Keller 1979, Olson et al. 1979, Van Velson 1979). Fencing can protect the fisheries resource from the effects of grazing in the riparian zone, but fencing is not a complete solution to riparian problems. Fencing is costly, anywhere from $1,500 to $3,100 per ha of stream (Busby 1979). Esthetically, it is displeasing. Despite the drawbacks of fencing, it can improve degraded riparian areas for later grazing and provide a means of controlling the level use.

Rest-rotation grazing has been discussed as a solution, but further studies need to be done to determine just what it can accomplish in riparian zones. Vegetation can be maintained or improved under this system after a complete rest of the riparian zone from grazing (Davis 1977, Storch 1979). Further study is needed to ascertain if rest-rotation grazing has resulted in good fish and wildlife riparian habitat (Olson et al. 1979).

Guidelines and recommendations for sound management of riparian zones have been suggested by many concerned with livestock and wildlife uses in these

areas. They are used in combination or alone:

-- Complete rest of riparian areas until these systems are restored (Behnke 1977, Storch 1979, Wamblodt 1979).

-- Dispersal of livestock throughout upland and riparian areas by such methods as salting, riding, or use of pipelines to divert water to other areas (Davis 1977, Swan 1979, Wamboldt 1979).

-- Fencing of springs, specific reaches, and rreas of critical concern (Armour 1979, Swan 1979).

-- Construction of demonstration areas to determine livestock impacts in, and compatibility with, riparian areas under various grazing systems (Behnke et sl. 1977, USDA-Forest Service 1978f, Miller 1979).

Riparian habitat should be included in range analyses so that condition of these areas can be determined. The Range Analysis Handbook (USDA-Forest Service 1977b) contains direction for vegetative inventory which can, and should, be used in riparian areas. Although developed for upland areas, transect methods can be used to inventory riparian vegetation, both its condition and trend. This requires the placement of benchmarks within riparian zones and monitoring of the forage production specifically found there. All inventories should sample areas representative of the riparian ecosystem as opposed to the upland ecosystem so that a true estimate of its condition and stocking capacity can be arrived at. Management should be prescribed to provide adequate protection of riparian areas from overuse.

Wildlife

Excessive numbers of deer and elk on winter range can be detrimental to riparian vegetation. Construction of beaver dams may reduce the quality of the water resource by increasing sediment loads and decreasing stream flow. In most cases wildlife impacts are temporary, and vary in severity from year to year. Still, such impacts can greatly effect the riparian ecosystem. Possible solutions include:

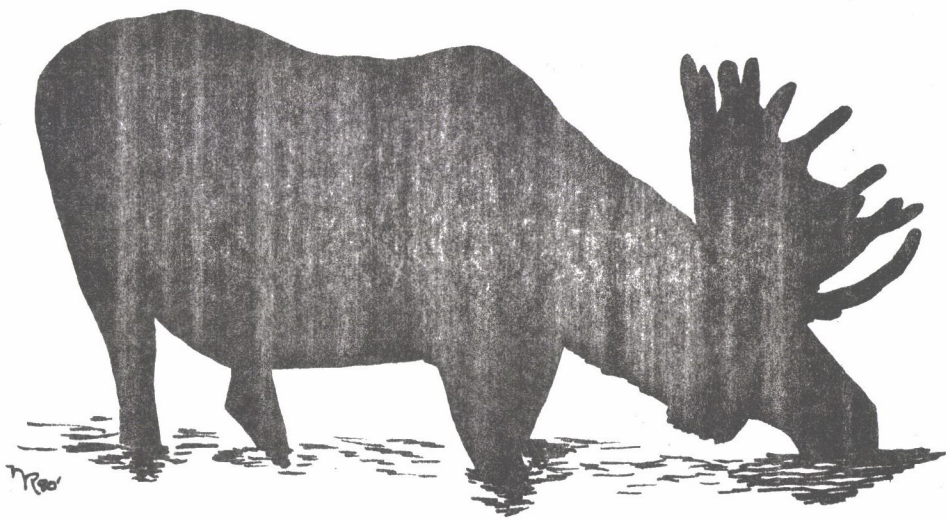
-- Opening existing roads to allow greater hunter access.

-- Recommending to other agencies what areas might be able to sustain a greater harvest of game.

-- Manipulating riparian vegetation to affect cover/forage ratios.

-- Developing alternative watering areas or use salting techniques to increase wildlife dispersal.

It is important to note that in managing for one species it may be to the detriment of another. Sound judgment must be used by managers to insure that corrective measures for one species do not pose an even greater problem for another.



FURTHER RESEARCH

The complexity of the riparian ecosystem requires further research to understand and correctly manage its resources. We have only begun to recognize the problems which arese with multiple use management of these sites. The National Riparian Task Force Report cited the following as riparian research needs for the future:

--"Inventory, assessment, and classification;

-- Ecosystem dynamics;

-- Autecology and physiology of deciduous tree species;

-- Impacts of land management practices;

-- Social and ecomomic problems; and

-- Riparian management alternatives."

The report also cited the need for a state-of-the-art paper to be developed on the effects of management actions on riparian ecosystems (USDA-Forest Service 1979a).

CONCLUSION

Concern for riparian ecosystems has now begun to intensify in the Northern Region. But where do we go from here? Land managers must work closely with researchers involved in riparian ecosystem management, in order to implement new findings. Meanwhile, efforts must be directed at the mapping and inventory of these areas, and the types and condition of riparian vegetation must be determined. Data is needed concerning the ecological relationships found in riparian ecosystems and how they are balanced. How are wildlife using riparian ecosystems in Region 1? What can be done to insure adequate mapping of these areas through Forest Land Management Planning? Quality standards to measure the health or deterioration of riparian ecosystems need to be identified. Most importantly, a clear Forest Service policy concerning direction for riparian ecosystem management needs to be developed. Management objectives for the Northern Region should be identified to meet that policy so the results of riparian ecosystem management can be weighed. Sound management of riparian ecosystems will benefit many users over time, provided the necessary steps are taken to preserve the network of resources which comprise this unique ecosystem.

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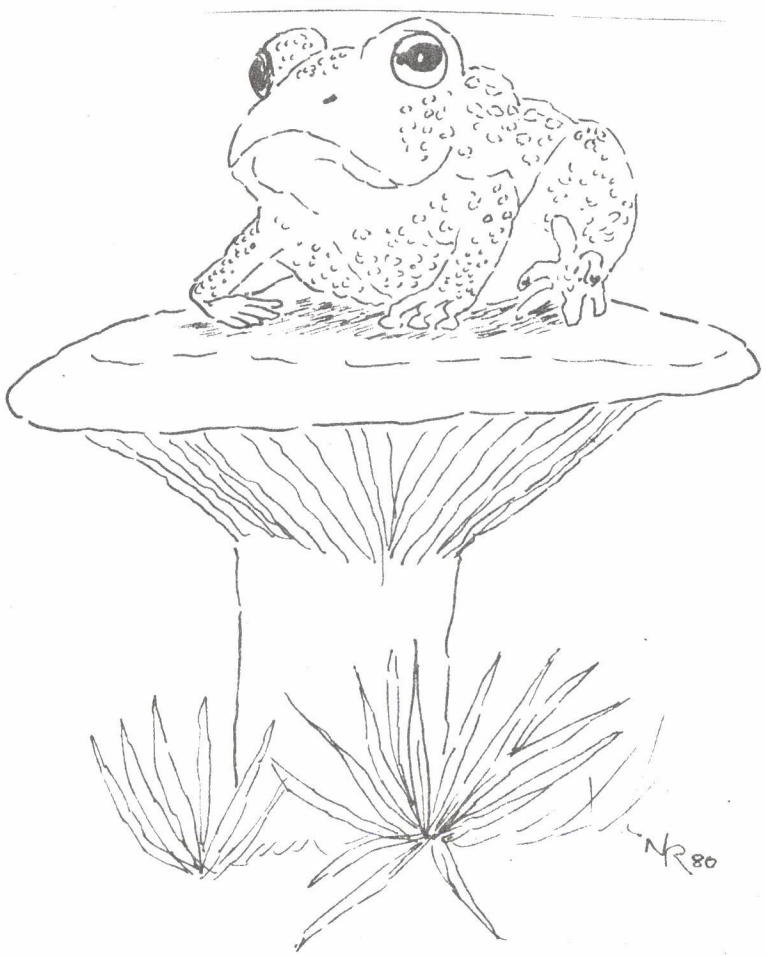


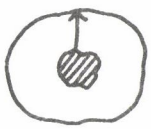
APPENDIX A

Calculation of the percent of riparian ecosystems contained in Forest System lands of the Northern Region.

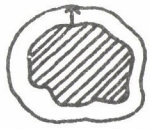
Numerous assumptions were made in order to estimate the percent of Northern Region lands comprising riparian ecosystems. Data from Table 1 were used in conjunction with the following assumptions:

1. The average width of riparian ecosystems along streams was assumed to be 91.5 m (300 ft) in total width, recognizing that some areas will be wider, some narrower.

2. Lakes were defined as small or large in size. Most natural lakes are small and it is believed that the amount of riparian vegetation around small lakes is generally larger than that around large lakes.
   Example:



small lake



large lake

3. A small lake was defined as any lake 40.5 ha (100 ac) in size or less. The area defined as riparian vegetation was estimated as one half the hectares of water.
   Example: If the small lake = 40.5 ha and the riparian vegetation = 20.25 ha, then the total riparian ecosystem lands = 40.5 + 20.25 = 60.75 ha (150 ac)

4. Large lakes were defined as any lakes over 40.5 ha (100 ac) in size. The area defined as riparian vegetation around large lakes was estimated at 10% of the hectares of water.

The following calculations were made based on the assumptions stated above and from data in Table 1:

$$54{,}863.7 \text{ km streams} \times \frac{15.2 \text{ ha streams}}{\text{km streams}} = 517{,}590 \text{ ha streams}$$

39,047.3 ha small lakes + 19,521 ha riparian vegetation
= 58,563 ha total riparian small lakes

39,933 ha large lakes + 3,993.3 ha riparian vegetation
= 43,926.3 ha total riparian large lakes

43,926.3 ha + 58,563 ha + 517,590 ha = 620,079.3 ha of total riparian lands in Region 1.

APPENDIX A (cont.)

Assuming 10,530,000 ha of land contained in Region 1, then:

$$\frac{620{,}079.3 \text{ ha}}{10{,}530{,}000 \text{ ha}} = 5.9\% \text{ of the lands in Region 1 are riparian ecosystems.}$$

APPENDIX B

DEFINITIONS

Action: "Any Federal activity including (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing Federally undertaken, financed, or associated construction and improvements; and (3) conducting Federal activities and programs affecting land use including, but not limited to, water and related land resource planning, regulating, and licensing activities" (U.S. Water Resources Council 1978).

Areas of Environmental Concern: "Areas within the public lands where special management attention is required . . . to protect and prevent irreparable damage to important . . . fish and wildlife resources or other natural systems or processes . . . ." (U.S. 94th Congress 1976).

Directives System: "The Forest Service Directives System comprised of the Forest Service Manual and related Forest Service Handbooks" and provides "procedures for the conduct of Forest Service activities" as issued by the central office of the Forest Service and by its field officer (USDA-Forest Service 1978g).

Floodplain: "The lowland and relatively flat areas joining inland and coastal waters including debris cones and flood-prone areas of offshore islands, including at a minimum, that area subject to a 1-percent (100-year recurrence) or greater chance of flooding in any given year"(USDA-Forest Service 1979f).

Riparian Ecosystem: "Includes the stream channel, lake or estuary bed, the water itself, the banks, and the areas which support riparian vegetation and other characteristics that exist because of the presence of water. This definition includes those lands defined as wetlands and flood plains which support riparian vegetation" (USDA-Forest Service 1979a).

Riparian Vegetation: "Vegetation dependent upon an excess of moisture during a portion of the growing season and the site is definitely more moist than the surrounding area" (USDA-Forest Service 1979a).

Wetlands: "Those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds" (U.S. Water Resources Council 1978).

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